Claims

What is claimed is:

1. A method for encoding an audio signal comprising the steps of:

receiving the audio signal;

providing a model relating to temporal masking of sound provided to a human ear;

determining a temporal masking index in dependence upon the received audio signal and the model;

determining a masking threshold in dependence upon the temporal masking index using a psychoacoustic model; and,

encoding the audio signal in dependence upon the masking threshold.

2. A method for encoding an audio signal as defined in claim 1, wherein the temporal masking index is determined using a forward temporal masking function.

3. A method for encoding an audio signal as defined in claim 2, wherein the temporal masking index is determined using a backward temporal masking function.

4. A method for encoding an audio signal as defined in claim 3, wherein the temporal masking index is determined on a frame by frame basis for each sample of a frame of the audio signal.

5. A method for encoding an audio signal as defined in claim 4, wherein the temporal masking index is determined for each sample of a frame based on the samples of the frame, samples of a previous frame, and samples of a following frame.

6. A method for encoding an audio signal as defined in claim 5, comprising the step of calculating an average energy of the samples.

7. A method for encoding an audio signal as defined in claim 6, wherein the temporal masking index is determined in time domain.

8. A method for encoding an audio signal as defined in claim 7, comprising the step of determining a simultaneous masking index.

9. A method for encoding an audio signal as defined in claim 8, comprising the step of determining a combined masking index by combining the temporal masking index and the simultaneous masking index.

10. A method for encoding an audio signal as defined in claim 9, wherein the temporal masking index and the simultaneous masking index are combined using a power-law.

11. A method for encoding an audio signal as defined in claim 10, wherein the steps of determining a simultaneous masking index and determining a combined masking index are performed in frequency domain.

12. A method for encoding an audio signal as defined in claim 11, wherein the psychoacoustic model is the MPEG-1 psychoacoustic model 2.

13. A method for encoding an audio signal comprising the steps of:

receiving the audio signal;

determining an inharmonicity index in dependence upon the received audio signal;

determining a masking threshold in dependence upon the inharmonicity index using a psychoacoustic model; and,

encoding the audio signal in dependence upon the masking threshold.

14. A method for encoding an audio signal as defined in claim 13, comprising the steps of:

decomposing the audio signal using a plurality of bandpass auditory filters, each of the filters producing an output signal;

determining an envelope of each output signal using a Hilbert transform;

determining a pitch value of each envelope using autocorrelation;

determining an average pitch error for each pitch value by comparing the pitch value with the other pitch values;

calculating a pitch variance of the average pitch errors; and,

determining the inharmonicity index as a function of the pitch variance.

15. A method for encoding an audio signal as defined in claim 14, wherein the inharmonicity index covers a range of 10 dB.

16. A method for encoding an audio signal as defined in claim 15, wherein the inharmonicity index for a perfect harmonic signal has a zero value.

17. A method for encoding an audio signal as defined in claim 14, wherein the plurality of bandpass auditory filters comprises a gammatone filterbank.

18. A method for encoding an audio signal as defined in claim 17, wherein a lowest frequency of the gammatone filterbank is chosen such that the auditory filter centered at the lowest frequency passes at least two harmonics.

19. A method for encoding an audio signal as defined in claim 18, wherein the lowest frequency is set to twice the inverse of the median of the pitch values.

20. A method for encoding an audio signal as defined in claim 18, wherein the psychoacoustic model is a MPEG psychoacoustic model.

21. A method for encoding an audio signal as defined in claim 20, wherein a Tone-Masking-Noise Parameter of the MPEG-1 psychoacoustic model 2 is modified using the inharmonicity index.

22. A method for encoding an audio signal as defined in claim 13, comprising the steps of:

determining a temporal masking index in dependence upon the received audio signal; and,

determining a masking threshold in dependence upon the inharmonicity index and the temporal masking index using a psychoacoustic model.

23. A method for encoding an audio signal comprising the steps of:

receiving the audio signal;

determining a non-linear masking index in dependence upon human perception of natural characteristics of the audio signal;

determining a masking threshold in dependence upon the non-linear masking index using a psychoacoustic model; and,

encoding the audio signal in dependence upon the masking threshold.

24. A method for encoding an audio signal as defined in claim 23, wherein the psychoacoustic model is the MPEG-1 psychoacoustic model 2.

25. A method for encoding an audio signal as defined in claim 24, wherein the non-linear masking index is a temporal masking index.

26. A method for encoding an audio signal as defined in claim 24, wherein the non-linear masking index is an inharmonicity index.

27. A method for encoding an audio signal comprising the steps of:

receiving the audio signal;

determining a masking index in dependence upon human perception of natural characteristics of the audio signal other than intensity or tonality such that a human perceptible sound quality of the audio signal is retained;

determining a masking threshold in dependence upon the masking index using a psychoacoustic model; and,

encoding the audio signal in dependence upon the masking threshold.

28. A method for encoding an audio signal as defined in claim 27, wherein the psychoacoustic model is the MPEG-1 psychoacoustic model 2.

29. A method for encoding an audio signal as defined in claim 28, wherein the non-linear masking index is a temporal masking index.

30. A method for encoding an audio signal as defined in claim 28, wherein the non-linear masking index is an inharmonicity index.

31. A method for encoding an audio signal comprising the steps of:

receiving the audio signal;

determining a masking index in dependence upon human perception of natural characteristics of the audio signal by considering at least a wideband frequency spectrum of the audio signal;

determining a masking threshold in dependence upon the masking index using a psychoacoustic model; and,

encoding the audio signal in dependence upon the masking threshold.

32. A method for encoding an audio signal as defined in claim 31, wherein the wideband frequency spectrum is the complete frequency spectrum of the audio signal.

33. A method for encoding an audio signal as defined in claim 31, wherein the psychoacoustic model is the MPEG-1 psychoacoustic model 2.

34. A method for encoding an audio signal as defined in claim 33, wherein the non-linear masking index is a temporal masking index.

35. A method for encoding an audio signal as defined in claim 33, wherein the non-linear masking index is an inharmonicity index.